# 7 Flight Summaries

The CBLAST-Low pilot study was conducted during a three-week period in July and August 2001 off the south shore of Martha's Vineyard Island, Massachusetts. A total of twenty missions (~ 48 flight hours) were flown by N3R on days with light winds (< 7 m $s^{-1}$) under various atmospheric stabilities. Numerous flux legs and MABL profiles were acquired during the course of the study. When possible, N3R flew over other CBLAST-Low "assets", including the R/V *Asterias*, the Air-Sea Interaction Meteorology (ASIMET) buoy (40° 59.5' N, 70° 35.9' W), and a three-dimensional SST array (41° 15.0' N, 70° 36.0' W).

All N3R flights were based out of the Martha's Vineyard Airport (MVY). Table 6 is a summary listing of flights during the CBLAST-Low pilot study. Included is the flight number, date, filename, start and end times for each file (UTC), number of scans (seconds) for each file, approximate flight hours, and miscellaneous comments. Flight hours were determined by a Hobbs meter, which keeps track of time from when the aircraft engine is started until it is shutdown. Appendix B contains figures of N3R flight tracks. The following is a brief summary of each flight.

## 7.1 Flight 1 (21 JUL 01)

The region was dominated by high pressure, clear skies, and relatively dry (low humidity) conditions. Winds were initially calm in the early morning hours becoming southwesterly at about 4 m $s^{-1}$ by late morning to early afternoon. The first CBLAST-Low flight (Fig. 19) included roll and pitch radar calibration maneuvers, twelve low-level (~ 10 m) north-south flux legs, and two MABL profiles.

## 7.2 Flight 2 (22 JUL 01)

The coastal waters of southern New England were dominated by high pressure, clear skies but with a slight increase in humidity. Winds were initially calm around sunrise and became southwesterly at 2 to 3 m $s^{-1}$ by mid-morning. A simple north-south, east-west box pattern (Fig. 20) was flown at about ~ 10 m in the early morning flight to acquire mean wind and turbulent flux data to validate satellite-based synthetic aperture radar (SAR) derived winds. The SAR overpass for waters south of Martha's Vineyard and Nantucket occurred at 1049 UTC. Two MABL profiles were also included in the flight.

## 7.3 Flight 3 (23 JUL 01)

Thick early morning fog eventually cleared by late morning with southwesterly winds of about 4 to 5 m $s^{-1}$ with gusts up to 8 to 9 m $s^{-1}$. The early afternoon flight (Fig. 21) included six north-south flux legs over the ASIMET buoy, multiple short altitude profiles (~ 150 m), and roll and pitch radar calibration maneuvers.

**Table 6.** Summary of N3R flights.

| FL | Date | File Name | Start/End Time (UTC) | | Scans | FL Hr | Flight Pattern |
|---|---|---|---|---|---|---|---|
| 1 | 21 JUL 01 | 07211228 | 12:58:29 | 16:29:01 | 12633 | 3.4 | north-south flux legs, radar calibration maneuvers |
| 2 | 22 JUL 01 | 07220953 | 10:04:45 | 11:27:42 | 4978 | 1.4 | SAR intercomparison |
| 3 | 23 JUL 01 | 07231646 | 16:50:15 | 19:13:14 | 8580 | 2.4 | north-south flux legs, radar calibration maneuvers |
| 4 | 25 JUL 01 | 07251641 | 16:54:11 | 18:52:47 | 7117 | 2.0 | north-south flux legs, IR camera runs |
| 5 | 27 JUL 01 | 07271211 | 12:31:32 | 16:32:30 | 14459 | 4.0 | north-south flux legs, IR camera runs |
| 6 | 27 JUL 01 | 07272229 | 22:37:34 | 23:14:04 | 2191 | 0.7 | “mowing the lawn” IR camera runs |
| 7 | 28 JUL 01 | 07281042 | 11:02:21 | 13:59:25 | 10625 | 3.0 | multi-directional flux legs, IR camera runs |
| 8 | 29 JUL 01 | 07290928 | 09:31:22 | 10:18:13 | 2806 | 1.5 | sunrise IR camera runs |
| 9 | 29 JUL 01 | 07291112 | 11:43:54 | 13:46:36 | 7363 | 2.0 | “spirograph” flux legs |
| 10 | 30 JUL 01 | 07301120 | 11:43:48 | 15:10:56 | 12429 | 3.5 | east-west “bow tie” flux legs, IR camera runs, wind calibration maneuvers |
| 11 | 31 JUL 01 | 07310909 | 09:29:00 | 11:52:59 | 8640 | 2.4 | north-south “bow tie” flux legs, sunrise “mowing the lawn” IR camera runs |
| 12 | 01 AUG 01 | 08010911 | 09:40:09 | 12:54:59 | 11691 | 3.3 | SAR intercomparison, IR camera runs, “spirograph” flux legs |
| 13 | 01 AUG 01 | 08011644 | 16:54:29 | 19:40:33 | 9965 | 2.8 | “bow tie” flux legs over R/V *Asterias*, “spirograph” flux legs |
| 14 | 02 AUG 01 | 08021423 | 14:47:23 | 17:12:35 | 8713 | 2.4 | “spirograph” flux legs, IR camera runs |
| 15 | 03 AUG 01 | 08030052 | 00:58:21 | 02:22:29 | 5049 | 1.9 | nighttime “mowing the lawn” IR camera runs |
| 16 | 05 AUG 01 | 08051541 | 15:51:03 | 16:30:35 | 2373 | 0.7 | flight terminated due to heavy fog and poor visibility |
| 17 | 05 AUG 01 | 08052006 | 20:11:12 | 20:55:25 | 2654 | 0.8 | flight terminated due to heavy fog and poor visibility |
| 18 | 07 AUG 01 | 08071320 | 13:29:19 | 17:32:00 | 14558 | 4.1 | “spirograph” and “bow tie” flux legs |
| 19 | 08 AUG 01 | 08080955 | 10:03:04 | 14:01:50 | 14327 | 4.0 | SAR intercomparison, “spirograph” flux legs |
| 20 | 08 AUG 01 | 08081526 | 15:37:21 | 17:06:38 | 5358 | 1.5 | “bow tie” flux legs over R/V *Asterias* |

### 7.4 Flight 4 (25 JUL 01)

Moderate southwesterly winds of 5 to 6 m $s^{-1}$ were present during much of the day with shallow "puffs" of low-level fog moving over the island in the early afternoon. Four north-south flux legs were flown (Fig. 22) from near the coast over the 3D SST array and past the ASIMET buoy. The UW/WHOI camera system was installed on the day before this flight. Several transects were flown at about 400 m for the UW/WHOI camera system. Visibility at this level was poor because of the fog banks under N3R. Because of the poor visibility, visual navigation and reference to surface ships and buoys was difficult.

### 7.5 Flight 5 (27 JUL 01)

A cold front had moved through the region on the previous evening. A northeasterly wind of 4 to 6 m $s^{-1}$ created a dry, well-mixed MABL. This flight (Fig. 23) included numerous north-south flux legs extending from near the Martha's Vineyard Coastal Observatory (MVCO) meteorological tower to the ASIMET buoy. Three MABL profiles and high altitude (~ 400 m) UW/WHOI camera runs were also included.

### 7.6 Flight 6 (27 JUL 01)

The wind speed decreased by late afternoon and early evening to less than 3 m $s^{-1}$ for the second flight of the day. For this mission, a "mowing the lawn" or "radiator" pattern was flown by N3R (Fig. 24) at 400 m to map out SST variability by the UW/WHOI camera system. The N3R data acquisition system was manually shut down prior to landing since power was needed for aircraft landing lights.

### 7.7 Flight 7 (28 JUL 01)

The region continued to enjoy fair weather dominated by high pressure system with light northwesterly winds of 3 m $s^{-1}$ in early morning. By late morning the wind direction became northeasterly and remained fairly light (~ 3 m $s^{-1}$). Numerous low-level flux legs were flown by N3R (Fig. 25) over the ASIMET buoy with shallow profiles at the ends of each flux leg. Three MABL profiles were also included in the flight. High level camera runs flown for the UW/WHOI camera system at the beginning of the mission.

### 7.8 Flight 8 (29 JUL 01)

High pressure continued to dominate the weather with a few mid- and high-level clouds moving into the region. Winds were calm to very light and variable (< 2 m $s^{-1}$) for this early morning flight which started prior to sunrise. A simple north-south, east-west box pattern was flown (Fig. 26) at 400 m for the UW/WHOI camera system. The box was to be repeated at low levels for a SAR intercomparison, however, the flight was terminated because the TANS-vector GPS was not outputting valid pitch, roll, and heading solutions. It should be noted that the data file begins after take off in an attempt to reinitialize the TANS-vector GPS.

### 7.9 Flight 9 (29 JUL 01)

Once the TANS-vector GPS was properly reinitialized about an hour after the end of Flight 8, N3R conducted a flux mission utilizing a "spirograph" pattern centered over the ASIMET buoy with multiple short profiles (~ 150 m) at the end of each flux leg (Fig. 27). This pattern has the advantage of quickly mapping the spatial variability of the atmosphere and ocean in about an hour A MABL profile was also included during this flight. The first twenty three minutes of the data file were not differentially corrected due to a brief power outage which shut down the ground station computer.

### 7.10 Flight 10 (30 JUL 01)

Fair weather continued to dominate the coastal waters with high clouds to the south from a low pressure system in the mid-Atlantic region. Light winds of about 2 to 3 m $s^{-1}$ from the northeast were present in the early morning, increasing to about 5 to 6 m $s^{-1}$ and from the east by late morning. Wind calibration maneuvers were included in this flight, along with three MABL profiles, a box pattern at 400 m for the UW/WHOI camera system, east-west "bow tie" flux legs and shallow profiles over ASIMET buoy, and multiple flux legs and short profiles over the R/V *Asterias*. which surveyed the waters several kilometers off the coast of Martha's Vineyard (Fig. 28).

### 7.11 Flight 11 (31 JUL 01)

Fair weather continued to persist with a few high clouds from a low pressure system to the south which was quickly moving to the northeast. Light winds of 2 to 3 m $s^{-1}$ were from the north. The flight included another "mowing the lawn" pattern prior to and shortly after sunrise for the UW/WHOI camera system, two MABL profiles, and seven northeast-southwest flux legs over the ASIMET buoy (Fig. 29).

### 7.12 Flight 12 (01 AUG 01)

High pressure continued to dominate the region with very light winds of 2 to 3 m $s^{-1}$from the northwest to northeast. N3R flew a simple north-south, east-west box prior to sunrise for the UW/WHOI camera system prior and repeated the same exact flight track at 10 m during a SAR overpass which occurred at 1057 UTC (Fig. 30). A "spirograph" flux pattern was flown over the ASIMET buoy with multiple shallow profiles at the end of each flux leg. Three MABL profiles were also included in this flight.

### 7.13 Flight 13 (01 AUG 01)

Flight 13 was the second flight of the day. Winds continued to be light and variable under fair weather. Numerous east-west "bow tie" flux legs were flown in the vicinity of the R/V *Asterias* several kilometers off the coast of Martha's Vineyard (Fig. 31). Another "spirograph" flux pattern was flown again over the ASIMET buoy. Two MABL profiles were included in this flight.

### 7.14 Flight 14 (02 AUG 01)

Very hazy, hot, and humid conditions were present as a high pressure system slowly moved eastward. Winds were about 4 to 5 m $s^{-1}$ from the southwest. The late morning flight included a simple north-south, east-west box pattern for the UW/WHOI camera system and a "spirograph" flux pattern over the ASIMET buoy with multiple shallow profiles at the end of each flux leg (Fig. 32). Two MABL profiles were included in this flight.

### 7.15 Flight 15 (03 AUG 01)

The weather continued to be hazy and humid with steady southwesterly winds of 5 to 6 m $s^{-1}$ as a high pressure system slowly moved eastward. A "mowing the lawn" pattern was flow at 400 m during this nighttime flight for the UW/WHOI camera system (Fig. 33). The N3R data acquisition system was booted up after takeoff and shut down prior to landing since power was needed for external and internal aircraft lights. Approximately 15 min of TANS-vector GPS data were lost about 40 min into the flight. The lack of available satellites may be a possible reason why this instrument failed to provide valid solutions. The UW/WHOI camera system was removed after the end of this flight.

### 7.16 Flight 16 (05 AUG 01)

Hazy, hot, and humid conditions prevailed with light southwesterly winds of 2 to 3 m $s^{-1}$ ahead of a stalled cold front. This flight was terminated shortly after take off because of heavy offshore fog and very poor visibility (Fig. 34).

### 7.17 Flight 17 (05 AUG 01)

A second N3R mission was attempted later on the same day. The weather continued to be hazy, hot, and humid with light southwesterly of 4 to 5 m $s^{-1}$. Once again, the flight was terminated shortly after take off because of heavy offshore fog and very poor visibility (Fig. 35). Note that the N3R data acquisition was shut down prior to landing.

### 7.18 Flight 18 (07 AUG 01)

The weather continued to be hazy, hot, and humid, moderate southwesterly winds of 4 to 6 m $s^{-1}$ ahead of a stalled cold front. Flight visibility was only about 1 km. Two sets of "spirograph" and "bow tie" flux patterns were flown near the coastline and over the ASIMET buoy (Fig. 36). A single MABL profile was included in this flight. DGPS corrections failed about 15 minutes before the end of the flight.

### 7.19 Flight 19 (08 AUG 01)

Hazy, very hot, and humid conditions persisted with light and variable winds ahead of a stalled cold front. N3R flew a simple north-south, east-west box during a SAR overpass which

occurred at 1053 UTC (Fig. 37). Two “spirograph” flux patterns were flown near the coastline and over the ASIMET buoy with multiple shallow profiles at the end of each flux leg. Three MABL profiles and various calibration maneuvers were also included in this flight. Note that DGPS corrections were not available for the first twenty one minutes of the flight because the GPS ground station was started late.

### 7.20 Flight 20 (08 AUG 01)

N3R flew a second time in the early afternoon on the same day. The weather continued to be hazy, very hot, and humid with light and variable winds. This flight was dedicated to numerous low-level north-south flux legs from the coastline over the R/V *Asterias* (Fig. 38). A single MABL profile was included at the end of the flight.